



Standard Test Method for Density of Soil and Rock in Place by the Water Replacement Method in a Test Pit¹

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1. Scope

1.1 This test method covers the determination of the in-place density and unit weight of soil and rock using water to fill a lined test pit to determine the volume of the test pit. The use of the word “rock” in this test method is used to imply that the material being tested will typically contain particles larger than 3 in. (75 mm).

1.2 This test method is best suited for test pits with a volume between approximately 3 and 100 ft³ (0.08 and 2.83 m³). In general, the materials tested would have maximum particle sizes over 5 in. (125 mm). This test method may be used for larger sized excavations if desirable.

1.2.1 This procedure is usually performed using circular metal templates with inside diameters of 3 ft (0.9 m) or more. Other shapes or materials may be used providing they meet the requirements of this test method and the guidelines given in Annex A1 for the minimum volume of the test pit.

1.2.2 Test Method D 4914 may be used as an alternative method. Its use, however, is usually only practical for volume determination of test pits between approximately 1 and 6 ft³ (0.03 and 0.17 m³).

1.2.3 Test Method D 1556 or Test Method D 2167 is usually used to determine the volume of test holes smaller than 1 ft³ (0.03 m³).

1.3 The two procedures are described as follows:

1.3.1 *Procedure A*—In-Place Density and Unit Weight of Total Material (Section 10).

1.3.2 *Procedure B*—In-Place Density and Unit Weight of Control Fraction (Section 11).

1.4 *Selection of Procedure:*

1.4.1 Procedure A is used when the in-place unit weight of total material is to be determined. Procedure A can also be used to determine percent compaction or percent relative density when the maximum particle size present in the in-place material being tested does not exceed the maximum particle size allowed in the laboratory compaction test (Test Methods

D 698, D 1557, D 4253, D 4254, D 4564). For Test Methods D 698 and D 1557 only, the unit weight determined in the laboratory compaction test may be corrected for larger particle sizes in accordance with, and subject to the limitations of, Practice D 4718.

1.4.2 Procedure B is used when percent compaction or percent relative density is to be determined and the in-place material contains particles larger than the maximum particle size allowed in the laboratory compaction test or when Practice D 4718 is not applicable for the laboratory compaction test. Then the material is considered to consist of two fractions, or portions. The material from the in-place unit weight test is physically divided into a control fraction and an oversize fraction based on a designated sieve size. The unit weight of the control fraction is calculated and compared with the unit weight(s) established by the laboratory compaction test(s).

1.4.2.1 Because of possible lower densities created when there is particle interference (see Practice D 4718), the percent compaction of the control fraction should not be assumed to represent the percent compaction of the total material in the field.

1.4.3 Normally, the control fraction is the minus No. 4 sieve size material for cohesive or nonfree-draining materials and the minus 3-in. sieve size material for cohesionless, free-draining materials. While other sizes are used for the control fraction ($\frac{3}{8}$, $\frac{3}{4}$ -in.), this test method has been prepared using only the No. 4 and the 3-in. sieve sizes for clarity.

1.5 Any material can be tested, provided the material being tested has sufficient cohesion or particle attraction to maintain stable sides during excavation of the test pit and through completion of this test. It should also be firm enough not to deform or slough due to the minor pressures exerted in digging the hole and filling with water.

1.5.1 A very careful assessment must be made as to whether or not the volume determined is representative of the in-place condition when this test method is used for clean, relatively uniform-sized particles 3 in. (75 mm) and larger. The disturbance during excavation, due to lack of cohesion, and the void spaces between particles spanned by the liner may affect the measurement of the volume of the test pit.

1.6 This test method is generally limited to material in an unsaturated condition and is not recommended for materials that are soft or friable (crumble easily) or in a moisture

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